User Manual

UIM2501
CAN2.0B / RS232
Control Protocol Converter

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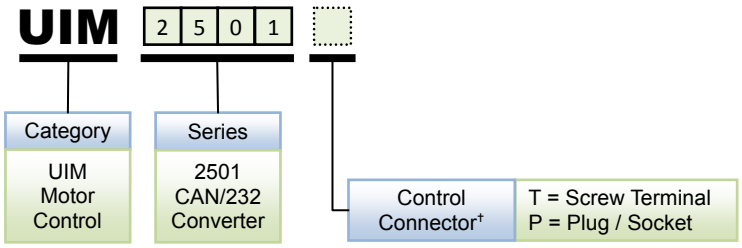
[UIM2501 Ordering Information]

In order to serve you quicker and better, please provide the product number in following format.

UIM2501 PART NUMBERING SYSTEM



Note: † If not selected, default control connector is T (screw terminal), the code box can be deleted.

Examples: UIM2501P, UIM2501

UIM2501
CAN/RS232 Control Protocol Converter
(For UIM242 Stepper Controller and UID820 CAN Digital I/O Controller)

FEATURES

Embedded DSP Microprocessor

- Embedded high-performance DSP
- Simple, intuitive, rich instructions
- Intelligent, fault-tolerating, user-friend interface
- MS Windows based VB / VC demo software and corresponding source code provided

RS232 Communication

- RS232 three wire serial communication

CAN2.0B Active Communication

- 2-wire interface
- Support 1M bps, long distance
- Differential data bus, high noise immunity

Wide Supply Voltage

- Wide supply voltage range from 6～40VDC

GENERAL DESCRIPTION

The UIM2501 RS232-CAN Converting Controller is used in conjunction with UIM242XX stepper motor controller to provide a RS232 interface on the user side and a CAN bus interface on the motor side (factory side).

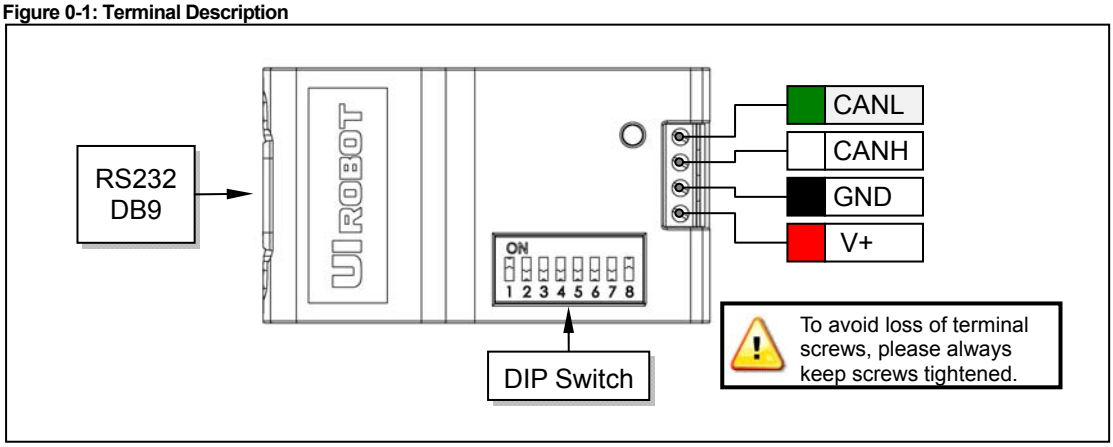
With the UIM2501, user will be benefited from the advantages of the CAN network and the simplicity of RS232 protocol, and no need to deal with the complicated CAN protocol, no worry about the communication distance and noise immunity.

One UIM2501 controller can network with up to 100 UIM242XX controllers. Interfacing the UIM2501 is simple, intuitive and fault tolerating. Users are not required to have stepper motor driving or CAN protocol knowledge.

UIM2501 is compact in size. The enclosure is made of die-cast aluminum to provide a rugged durable protection and improves the heat dissipation.

TERMINAL DESCRIPTION

Figure 0-1: Terminal Description



Description of Screw Terminals

Terminal No.	Designator	Description
1	V+	Supply voltage, 12 - 40VDC
2	GND	Supply voltage ground
3	CANH	CAN Dominant High
4	CANL	CAN Dominant Low

RS232 Connector

DB-9 (Female Pin) connector

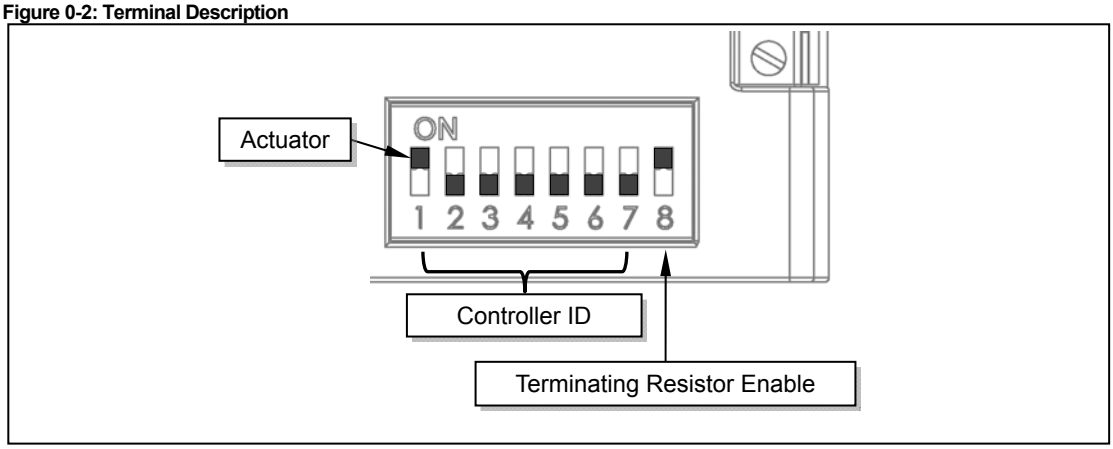
DIP SWITCH

UIM2501 controller has an 8-bit DIP switch, which serves multiple functions. When powering up, DIP1~DIP7 are read as the UIM2501 controller's ID/address. After powering up, DIP1 and DIP2 are assigned to other RS232 related features (refer to the "RS232 communication" section).

DIP8 is used to enable the built-in terminating resistor.

Unless necessary, please maintain the DIP positions as shown in following Figure.

Figure 0-2: Terminal Description



TYPICAL APPLICATION

UIM2501 converter can work with one UIM242 or UID820 controller or a set of UIM242 and UID820 controllers in a CAN network. Typical applications are described below.

Single Slave Operation

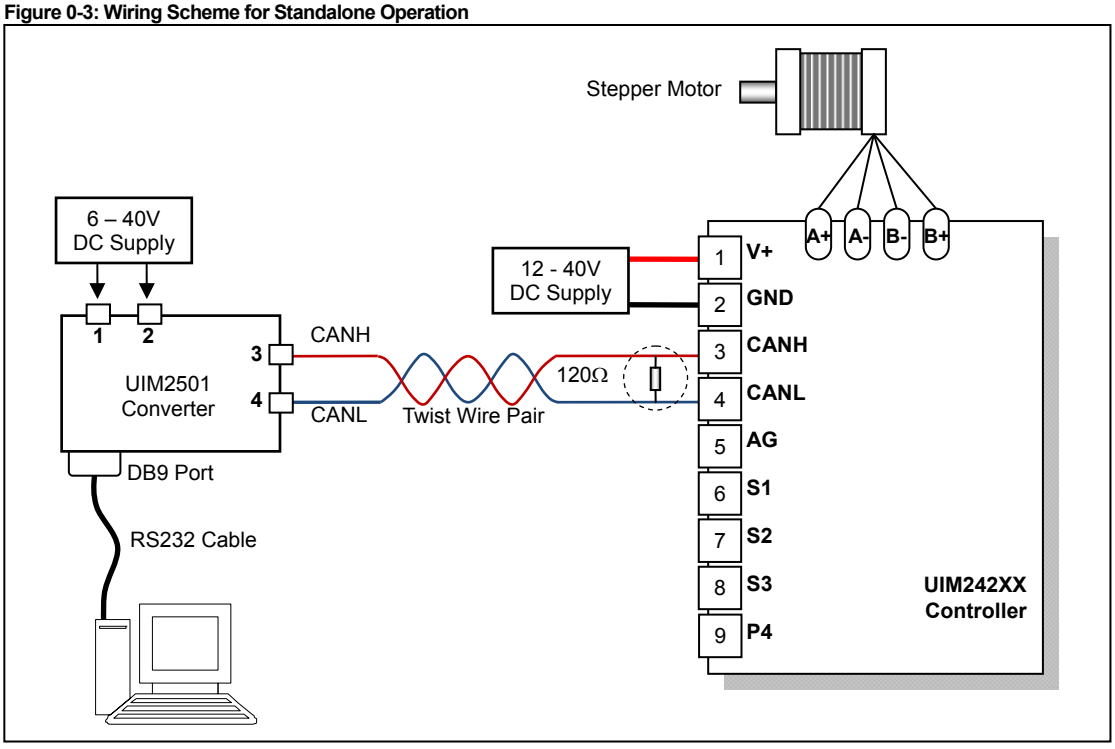
If only one UIM242 or UID820 is used, following wiring scheme (figure 0-3) can be applied. For the wiring scheme of UID820 digital IO controller, please refer to the UID820 user manual.

Please note that, this wiring scheme is mandatory when assigning a controller ID to a UIM242 controller (motor is not required). Details are provided in Section 4.1.

Please note: Both ends of the CAN bus should be terminated with120Ω terminating resistors. As UIM2501 converter has a build-in terminating resistor. To enable the terminating resistor, simply toggle the DIP8 to the ON position. On the UIM242 controller side, user needs to attach a resistor to the end of the bus as shown in figure 0-3.

Furthermore, CANH and CANL should be a twisted wire pair.

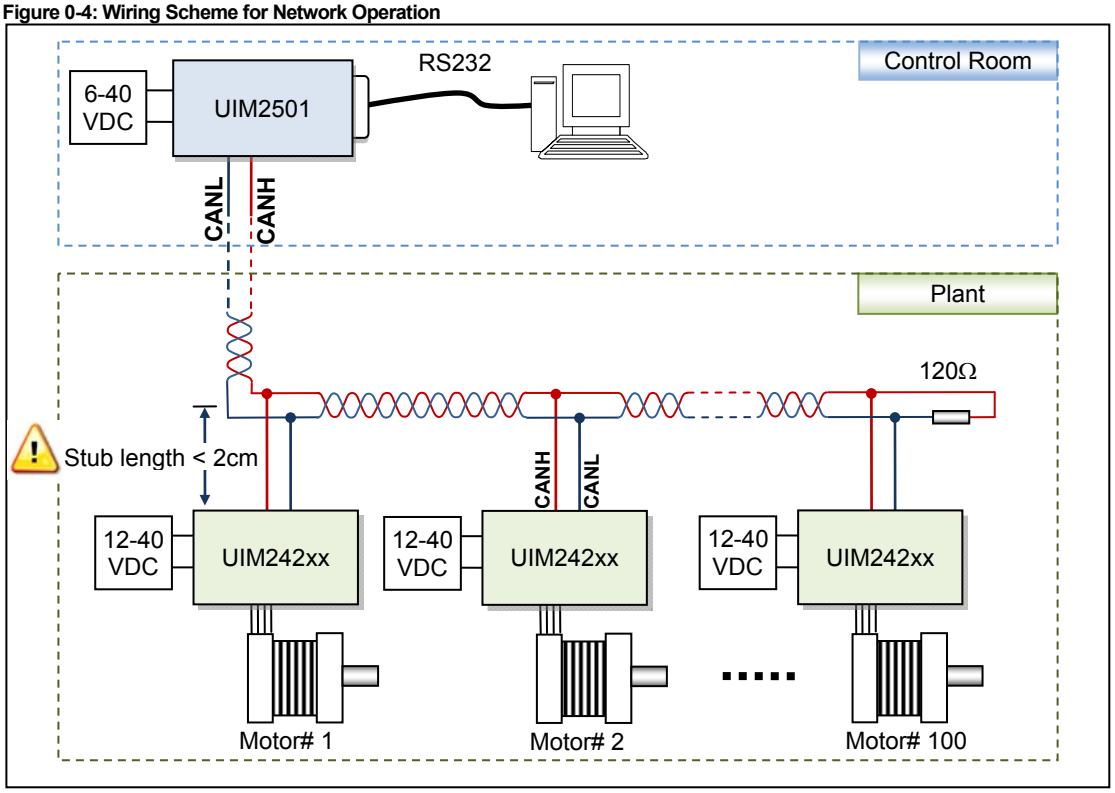
Figure 0-3: Wiring Scheme for Standalone Operation



Network Operation

Multiple UIM242 and UID820 controllers can be wired together to form a reliable CAN control network. Following figure provides a typical network wiring solution.

Figure 0-4: Wiring Scheme for Network Operation



Please be aware that:

In multi-node CAN applications, it is important to maintain a direct point-to-point wiring scheme. A single pair of wires should connect each element of the CAN bus, and the two ends of the bus should be terminated with 120Ω resistors. A star configuration should never be used.

UIM2501 converter has a build-in terminal resistor. To enable the UIM2501 converter's terminating resistor, please toggle the DIP8 to ON position. User only needs to attach a resistor at the UIM242 end of the bus.

In addition, any deviation from the point-to-point wiring scheme creates a stub. The high-speed edge of the CAN data on a stub can create reflections back down the bus. These reflections can cause data errors by eroding the noise margin of the system. Although stubs are unavoidable in a multi-node system, care should be taken to keep these stubs as small as possible.

INSTRUCTION SET SUMMARY

Instruction	Description	Feedback Header	Message ID
MDL=X;	Check the Model / Modules / Firmware of node x	0xCC	0xDE
MDL;	Check the Firmware Version of UIM2501	0xCC	0xDE
BDR=X;	Set RS232 baud rate	0xAA	0xBD
BTR=X;	Set CAN network communication bit rate index **x**	0xAA	0xBC
BTR;	Check current CAN network bit rate index	0xAA	0xBC
SETADR=X;	Assign an ID **x** to a UIM242XX controller	0xAA	0xDD
ADR=X;	Specify the operation object by node ID **x**	0xAA	0xD0
gREG;	Record the quantity of all subsidiary nodes and IDs	0xCC	0xD0
gENA;	Enable the H-Bridges of all nodes	0xAA	0xAD
gOFF;	Disable the H-Bridge of all nodes	0xAA	0xAD
gCUR=X;	Set motor phase current for all nodes	0xAA	0xAD
gACR=X;	Enable/disable the ACR function of all nodes	0xAA	0xAD
gMCS=X;	Set micro-stepping resolution for all nodes	0xAA	0xAD
gDIR=X;	Set desired motion direction for all nodes	0xAA	0xAD
gORG;	Set Original Point of all nodes	0xCC	0xAD
gSPD=X;	Set motor speed for all nodes	0xAA	0xAD
gSTP=X;	Setup relative position control for all nodes	0xAA	0xAD
gPOS=X;	Setup absolute position control for all nodes	0xAA	0xAD
gQEC=X;	Setup encoder based position control for all nodes	0xAA	0xAD
gDOUT=X;	Set the TTL level output of P4 ports of all nodes	0xAA	0xAD

CHARACTERISTICS

Absolute Maximum Ratings (†)

Supply Voltage..... 6V to 40V
Voltage on RX with respect to GND..... -25V to +25V
Voltage on TX with respect to GND..... -13.2V to +13.2V
Ambient temperature under bias……..... -20°C to +85°C
Storage temperature..... -50°C to +150°C

†NOTICE: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Electrical Characteristics (Ambient Temperature 25°C)

Supply Power Voltage	6V ~ 40VDC
Current Consumption	Max 100mA

Communication (Ambient Temperature 25°C)

To User Device	RS232
RS232 Wiring Method	DB9 Female Connector
RS232 Baud Rate	MAX 115200 bps
To UIM242 Controller	Active CAN 2.0B
CAN wiring Method	2-Wire, CANH, CANL
CAN bus	• Supports 1 Mb/s operation • ISO-11898 standard physical layer requirements • Suitable for 12V and 24V systems • Up to 100 nodes can be connected

Environment Requirements

Cooling	Free air
Working environment	Avoid dust, oil mist and corrosive gases
Working temperature	-40°C ~ 85°C
Humidity	<80%RH，no condensation, no frosting
Vibration	3G Max
Storage temperature	-50°C ~ 150°C

Size and Weight

Size	66.4mm x 38mm x 18mm (L*W*H)
Wight	0.1 kg

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1.0 OVERVIEW

UIM2501 RS232-CAN Converting Controller is used in conjunction with UIM242 stepper motor controller to provide a RS232 interface on the user side and a CAN bus interface on the motor controller side.

UIM2501 Controller's functions can be summarized as:

1. Receives RS232 based instructions from user device, converts the instructions into more concise and efficient CAN based instructions, and sends instructions to UIM242 controllers.
2. Converts CAN messages from UIM242 controllers into RS232 messages, and send back to the user devices.
3. Coordinates and controls UIM242 controllers in the network.

With the UIM2501, user will be benefited from the advantages of the CAN network and the simplicity of RS232 protocol, and no need to deal with the complicated CAN protocol, no worry about the communication distance and noise immunity.

One UIM2501 controller can network with up to 100 UIM242XX controllers. Interfacing the UIM2501 is simple, intuitive and fault tolerating. Users are not required to have stepper motor driving or CAN protocol knowledge. UIM2501 supports 1Mbps CAN communication speed. After optimization, all UIM242 instructions take less than 0.1 ms (normally 0.05 ms) to transfer on the bus. On the user side, UIM2501 supports 115200 bps RS232 baud rate.

UI Robot provides free Microsoft Windows XP bases VB / VC demo software and their source code to facilitate the quick start of user device side programming.

1.1 Instruction and Feedback Structure

As a protocol converter, UIM2501supports all instructions and conform to all instruction and feedback structures of UIM242XX and UID820. Therefore, this information is omitted in this manual. User can refer to the UIM242 and UID820 User Manuals for details.

1.2 Motor and I/O Control Functions and Instructions

Motor control specific functions, instructions and operations are directly performed by the UIM242 controllers. Digital I/O functions are performed by UID820. As a CAN/RS232 converter, UIM2501 accepts all the instructions described in the UIM242 and UID820 User Manuals. User can refer to the UIM242 and UID820 User Manuals for detailed information.

2.0 RS232 COMMUNICATION

UIM2501 controller communicates and exchanges information with user devices through the RS232 serial protocol. The RS232 configuration of user device, the hand-shaking methods, and the instruction used to change the baud rate will be introduce in this Chapter, along with the method to reset the baud rate to factory default.

2.1 Settings for User Device RS232 Port

To communicate with UIM2501, user device needs to have following RS232 port settings:

- 8 bits data
- 1 stop bit
- None Parity

2.2 Hand-Shaking

If user device knows the baud rate, it can start sending instructions without hand-shaking.

Hand-shaking is more used as a method to check the existence and firmware version of the controller. Hand-shaking is considered successful, if the user device receives a greeting message starting with a message header of “0xAA, 0xAB, 0xAC”.

Under following two situations the UIM2501 will issue the greeting message,

- when UIM2501 is powering up, and
- When UIM2501 receives following ASCII instruction: **ABC;** (case sensitive and ended with a semicolon).

The greeting message from UIM2501 has the following structure:

Byte	1	2	3	4	5	6	7	8	9	10	11	12	13
Value	0xAA	0xAB	0xAC	0x19	0x1	0	0	Firmware Version			0	0	0xFF

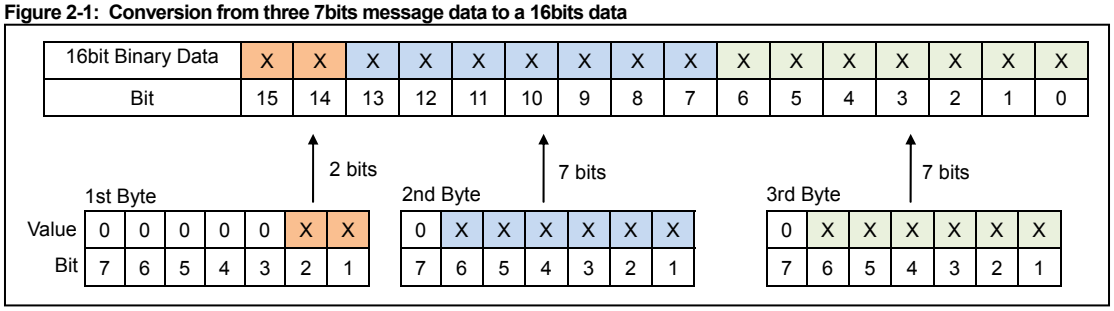
Where,

[0xAA] [0xAB] [0xAC] denotes the greeting message.

[0x19] [0x1] denotes the UIM2501 controller.

[Firmware Version] denotes the firmware version. Data is in 7 bits format. Conversion from three 7bits message data to a 16bits integer is illustrated in figure 2-1.

Figure 2-1: Conversion from three 7bits message data to a 16bits data


16bit Binary Data
X X X X X X X X X X X X X X X X
Bit
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
2 bits
7 bits
7 bits
1st Byte
2nd Byte
3rd Byte
Value
Bit
0 0 0 0 0 X X
7 6 5 4 3 2 1
0 X X X X X X
7 6 5 4 3 2 1
0 X X X X X X
7 6 5 4 3 2 1

Note: For above **[Firmware Version]**, Byte 8 / Byte 9 / Byte10 is the 1st Byte / 2nd Byte / 3rd Byte shown in figure 2-1 respectively.

2.3 Baud Rate Set Instruction (BDR)

Any out-of-box UIM2501 controller has a factory default baud rate 9600. User can use the 9600 baud rate to connect to a new UIM2501 controller.

To change to a different baud rate, user can use the instruction BDR as described below.

On receiving the BDR instruction, the new baud rate will be stored in the EEPROM and will take effect after the controller is restarted.

BDR = x;	
Function	Set RS232 BaudRrate.
Variable	Integer x = 9600 … 115200
ACK	0xAA [Reserved] 0xBD 0xFF
Comment	0xBD is the Message ID of instruction BDR. [Reserved] is for factory use. The new baud rate will be stored in the controller's non-volatile memory (EEPROM). New baud rate will take effect after the controller is restarted.

2.4 Reset Baud Rate to Factory Default 9600

In case that user forgets the UIM2501 baud rate and cannot establish the connection, following process can reset the baud rate to the factory default of 9600:

- Reboot the controller.
- In 10 seconds, toggle the DIP1 (DIP switch 1) for two rounds. During toggling, the LED on the controller will flash. If exceed 10 seconds, please restart from the first step.
- If step 2 is successful, the LED will turn off for one second and re-lit. That indicates the baud rate has been changed to 9600 and ready to use.
- The BDR instruction can be used to change the baud rate from 9600 now.

2.5 UIM2501 Version Check Instruction (MDL)

MDL;	
Function	Check the firmware version of UIM2501.
Variable	N/A
Feedback	0xCC [Reserved] 0xDE 0x19 0x1 0x0 0x0 V2 V1 V0 0xFF
Comment	0xDE is the Message ID of instruction MDL. V2 – V0 denote the firmware version. Data is in 7 bits format. Conversion from three 7bits message data to a 16bits data is illustrated in figure 2-1. [Reserved] is for factory use.

2.6 UIM242 Model and Version Check Instruction (MDL)

MDL=x;	
Function	Check the Model, installed modules and firmware version of the UIM242 controller with ID = **x**.
Variable	Integer x = 5, 6 … 125
Feedback	0xCC [Controller ID] 0xDE 0x18 0x2 [CUR] [ASM] V2 V1 V0 0xFF
Comment	0xDE is the Message ID of instruction MDL. [CUR] denotes the max phase current. e.g., “20” means 2.0 Amper. [ASM] denotes the installed optional modules. It has the following structure: bit 7 6 5 4 3 2 1 0 --- meaning 0 Int. QEC Closed-loop Adv. Motion No. of Sensor Ports For example, if bit 4 is 1, the Advanced Motion Control module is installed. V2 – V0 denote the firmware version. Data is in 7 bits format. Conversion from three 7bits message data to a 16bits data is illustrated in figure 2-1.

3.0 CAN2.0B COMMUNICATION

UIM2501 and UIM242XX support and realize following bit rate as shown in table 3-1. In the same time, instruction is provided for user to switch between these standard communication bit rates. Purpose of changing the bit rates includes obtaining longer bus length and more stable communication.

User can set the CAN network bit rate through setting the BTR (bit rate) index. The BTR switching instruction is “BTR = x;”, where, x is the BTR index. UIM242XX and UIM2501 all have a factory default value of 1, i.e. 800Kbps / 50 m bus length. Generally speaking, every instruction and/or message takes 64 – 128 bits.

Table 3-1 CAN Communication Bit Rates

BTR Index	Bit Rate (bps)	Bus Length (m)
0	1000K	25
1	800K	50
2	500K	100
3	250K	250
4	125K	500
5	50K	1000
6	20K	2500
7	10K	5000

3.1 Network CAN Bit Rate Set Instruction (BTR)

BTR=x;	
Function	Set CAN network bit rate index **x**.
Variable	Integer x = 0, 1 … 7
ACK	0xAA BTR# 0xBC 0xFF
Comment	0xBC is the Message ID of instruction BTR. BTR# is the desired bit rate index. After fulfills the “BTR=x;” instruction, the UIM2501 will automatically perform global registration process, i.e. process “gREG” instruction, and return following message. Details can be found in the following section of “gREG instruction”. 0xCC [Online Nodes QTY] 0xD0 A1 A2 A3 A4 A5 A6 A7 A8 0xFF

3.2 CAN Bit Rate Check

BTR;	
Function	Check current CAN network bit rate index.
Variable	N/A
ACK	0xAA BTR# 0xBC 0xFF
Comment	0xBC is the Message ID of instruction BTR. BTR# is the current bit rate index. Unlike “BTR=x;” instruction, There is no global registration process after “BTR;” instruction.

4.0 SINGLE AND NETWORK OPERATION

UIM2501 supports CAN networking. One UIM2501 can communicate with and control single or several UIM242 controller(s). Before operation, every UIM242 controller needs to be assigned a unique identification number (i.e., ID or address). Two or more UIM242 controllers with an identical ID in the network may cause the network malfunctioning. The process of ID assignment is described in following section.

4.1 Controller ID Assignment Instruction (SETADR)

All new UIM242xx controllers have been assigned a factory default ID of 5.

User can change the ID using SETADR instruction. Before assign an ID to a UIM242XX controller, please make sure the UIM2501 controller and the UIM242XX controller are connected together using the standalone operation scheme (Figure 0-3).

After powering up, user can use the following instruction to assign an ID to the UIM242XX controller.

SETADR=x; or **SET=x;**	
Function	Assign an ID **x** to a UIM242XX controller.
Variable	Integer x = 5, 6, 7 … 125
ACK	0xAA [Controller ID] 0xDD 0xFF
Comment	0xDD is the Message ID of SETADR. SETADR is the abbreviation of “Set Address”. Every time there can be only one UIM242XX controller linked to the UIM2501 controller to get the ID assigned. Once an ID is assigned, the ID will be stored in the UIM242XX controller’s non-volatile memory.

4.2 Object Specify Instruction (ADR)

To operate a specific UIM242xx controller, user needs to first notify the UIM2501 controller which UIM242 controller is suppose to receive instructions. Therefore, before sending motor control instructions, user needs to use the following instruction to specify the UIM242xx controller’s ID.

ADR=x;	
Function	Specify the operation object by node ID **x**.
Variable	Integer x = 5, 6, 7 … 125
ACK	0xAA [Controller ID] 0xD0 0xFF
Comment	0xD0 is the Message ID of ADR. ADR is the abbreviation of “address”. Once an operation object is specified, all object specific instructions will be sent to this specified object (the UIM242xx Controller), UNTILL another operation object (new ID) is specified.

After the specifying the Controller ID, user can use UIM242 instructions to control the specified controller. Those instructions are provided in the UIM242 user manual.

4.3 Global Control

Besides the object specific operation, UIM2501 can also send commands to all subsidiary UIM242XX controllers. This process is called broadcasting or global control instruction.

Global Instruction Format

Global control instructions have the same format as shown below: a leading “g” followed by the normal one-to-one operation instruction.

gXXX;

Where,

g denotes the global control instruction.

XXX is the object specific operation instructions, e.g., ACR, ENA, OFF, etc.

Global Instruction ACK Message

Except the instruction **gREG**, **BTR**, all global instructions have the same ACK message as shown below:

0xAA [QTY] 0xAD 0xFF

Where,

[QTY] is the quantity of all UIM242xx controllers that are operable.

[0xAD] is the Message ID of all global instructions.

Detailed global instructions are described in following sections.

4.4 Global Register Instruction (gREG)

gREG;	
Function	Record the quantity of all subsidiary UIM242 controllers and their IDs.
Variable	N/A
Feedback	0xCC [QTY] 0xD0 A1 A2 A3 A4 A5 A6 A7 A8 0xFF
Comment	QTY is the quantity of UIM242xx controllers found. 0xD0 is the Message ID of gREG. (Notice, 0xD0 also is the Message ID of ADR. However, ACK message of ADR is started with 0xAA, while the feedback message of gREG is started with 0xCC.) A1~A8 are the first 8 IDs found. An = 0 means not found. Once this instruction is executed by the UIM2501 Controller, the total number of all subsidiary UIM242xx controllers and their ID are recorded in the UIM2501 controller. The returned QTY servers as an indicator of the health of the network.

4.5 Global Motor Enable Instruction (gENABLE)

gENABLE; or **gENA;**	
Function	Enable the H-Bridges of all nodes (UIM242s).
Variable	N/A
ACK	0xAA [QTY] 0xAD 0xFF
Comment	User can first set the motion parameters to every UIM242xx Controller one by one, and then issue this instruction to enable all motors’ motion.

4.6 Global Motor Disable Instruction (gOFFLINE)

gOFFLINE; or **gOFF;**	
Function	Disable the H-Bridge of all nodes (UIM242s).
Variable	N/A
ACK	0xAA [QTY] 0xAD 0xFF
Comment	User can shutdown all motors using this instruction, especially in an emergency.

4.7 Global Motor Current Setup Instruction (gCUR)

gCUR=x;	
Function	Set motor phase current for all nodes (UIM242s).
Variable	Integer x = 0, 1 … 80
ACK	0xAA [QTY] 0xAD 0xFF

4.8 Global Auto Current Reduction Instruction (gACR)

gACR=x;	
Function	Enable/disable the ACR function of all nodes (UIM242s).
Variable	Integer x = 0, 1
ACK	0xAA [QTY] 0xAD 0xFF

4.9 Global Micro-Stepping Resolution Setup Instruction (gMCS)

gMCS=x;	
Function	Set micro-stepping resolution for all nodes (UIM242s).
Variable	Integer x = 1, 2, 4, 8, 16
ACK	0xAA [QTY] 0xAD 0xFF

4.10 Global Direction Instruction (gDIR)

gDIR=x;	
Function	Set desired motion direction for all nodes (UIM242s). (Obsoleted)
Variable	Integer x = 0, 1
ACK	0xAA [QTY] 0xAD 0xFF

4.11 Global Speed Setup Instruction (gSPD)

gSPD=x;	
Function	Set motor speed for all nodes (UIM242s).
Variable	Integer x = - 65000...-1, 0, 1 … 65000
ACK	0xAA [QTY] 0xAD 0xFF

4.12 Global Relative Position Control Instruction (gSTP)

gSTP=x;	
Function	Setup relative position control for all nodes (UIM242s).
Variable	Integer x = - 2,000,000,000...-1, 0, 1 …2,000,000,000
ACK	0xAA [QTY] 0xAD 0xFF

4.13 Global absolute Position Control Instruction (gPOS)

gPOS=x;	
Function	Setup absolute position control for all nodes (UIM242s).
Variable	Integer x = - 2,000,000,000...-1, 0, 1 …2,000,000,000
ACK	0xAA [QTY] 0xAD 0xFF

4.14 Global Encoder Based Position Control Instruction (gQEC)

gQEC=x;	
Function	Setup closed-loop encoder based position control for all nodes (UIM242s).
Variable	Integer x = - 2,000,000,000...-1, 0, 1 …2,000,000,000
ACK	0xAA [QTY] 0xAD 0xFF

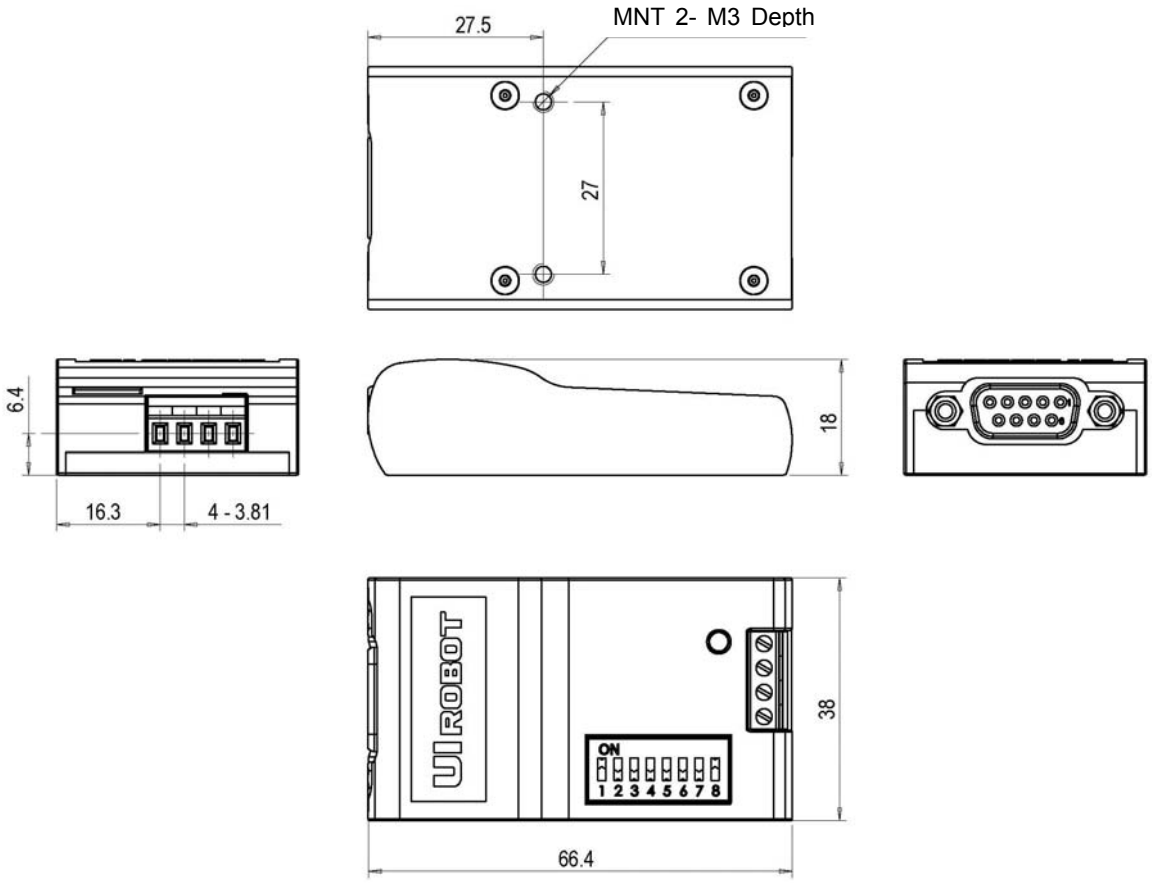
4.15 Global Origin Point Setup Instruction (gORG)

gORG=x;	
Function	Clear absolute position counters (including encoder) of all nodes (UIM242s).
Variable	N/A
ACK	0xAA [QTY] 0xAD 0xFF

4.16 Global TTL Level Output Instruction (gDOUT)

gDOUT=x;	
Function	Set the TTL level output of P4 ports of all nodes (UIM242s).
Variable	Integer x = 0, 1
ACK	0xAA [QTY] 0xAD 0xFF

APPENDIX A DIMENSIONS



Units: mm